T.O. 33A1-5-60-1

HANDBOOK
OPERATING AND SERVICE INSTRUCTIONS

WWV STANDARD FREQUENCY CALIBRATOR MODEL RH-10

(BROWNING)

THIS PUBLICATION REPLACES T.O. 33A1-5-60-1
(AN 16-30-17) DATED 22 MARCH 1954

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

RECEIVED
MARKETING

AF-WP-O-28 JAN 57 650

15 DECEMBER 1956

Reproduction for non-military use of the information or illustrations contained in this publication is not permitted without specific approval of the issuing service (BuAer or USAF). The policy for use of Classified Publications is established for the Air Force in AFR 205-1 and for the Navy in Navy Regulations, Article 1509.

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

* The asterisk indicates pages revised, added or deleted by the current revision.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES.—In accordance with Technical Order No. 00-5-2.
NAVAL ACTIVITIES.—Use Publications and Forms Order Blank (NavAer 2126) and submit to the nearest publications supply point listed below: NAS, Alameda, Calif.; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NAS, San Diego, Calif; NAS, Seattle, Wash.; NASD, ASO, Guam; NASD, Philadelphia, Pa.
For listing of available publications see Naval Aeronautic Publications Index (NavAer 00-500).

USAF

TABLE OF CONTENTS

Section		Page
I	DESCRIPTION	1
	1-1. Purpose of Equipment	1
	1-3. Principles of Operation	1
	1-5. Applications	1
	1-6. General	1
	1-7. Checking the Pitch of Musical Instruments	1
	1-8. Checking Clocks and Timing Devices	1
	1-9. Checking or Setting Audio Frequencies	1
	1-10. Checking or Setting RF Frequencies, or the Harmonics to the Carrier Frequencies of WWV	1
	1-11. Electrical Characteristics	1
	1-12. Power Input	1
	1-13. RF Sensitivity	1
	1-14. Selectivity	1
	1-15. Image Rejection Ratio	1
	1-16. Frequency	1
	1-17. Audio Output Voltage	1
	1-18. Output Impedance	1
	1-19. Equipment Supplied	1
	1-20. Equipment Required But Not Supplied	1
II	TEST EQUIPMENT AND SPECIAL SERVICE TOOLS	2
	2-1. Test Equipment	2
	2-3. Special Service Tools	2
III	PREPARATION FOR USE	2
	3-1. Connecting the Equipment	2
	3-3. Tuning and Aligning the Equipment	2
IV	OPERATION	2
	4-1. Operation of Equipment	2
	4-2. General	2
	4-3. Master Audio Gain	2
	4-4. Speaker Volume	2
	4-5. Function Selector	2
	4-10. Audio Output Level	2
	4-11. Frequency Megacycles Per Second	2
	4-12. Fine Tuning	2
	4-13. Starting Procedure	2
	4-14. Stopping Procedure	2
V	INSPECTION AND PREVENTIVE MAINTENANCE	3
	5-1. Periodic Inspection and Preventive Maintenance	3
	5-3. Lubrication	4
	5-5. Trouble Shooting	4
	5-6. General	4
	5-7. Replacement of Electron Tubes	5
	5-8. I-F Amplifier	7
	5-9. R-F Stages	7
	5-10. Selective Amplifier	7

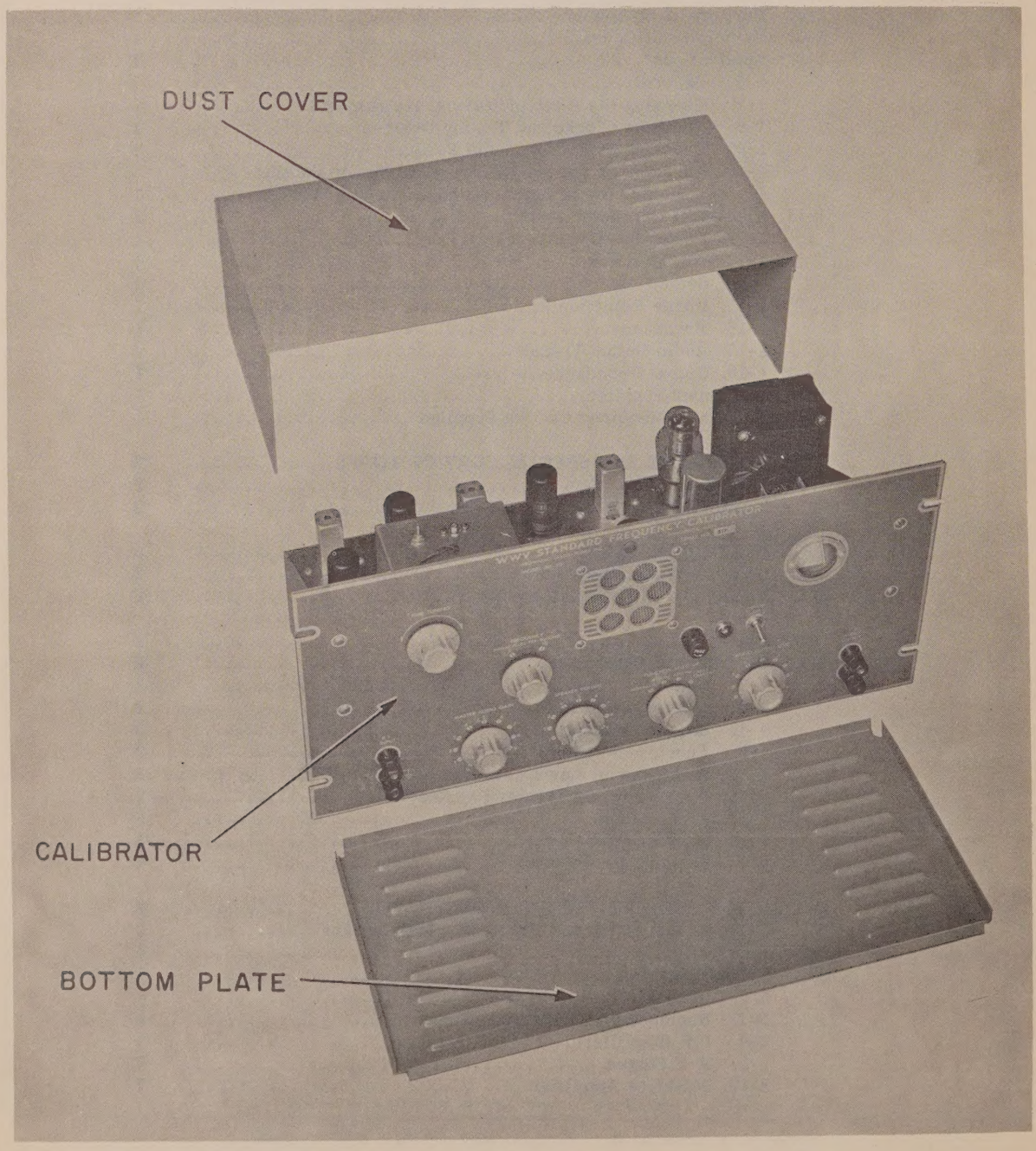


Figure 1-1. WWV Standard Frequency Calibrator, Model RH-10

SECTION I
DESCRIPTION

1-1. PURPOSE OF EQUIPMENT.

1-2. WWV Standard Frequency Calibrator, Model RH-10 (figure 1-1), is a special radio receiver designed by Browning Laboratories, Winchester, Massachusetts, for the reception of standard radio frequencies emanating from station WWV operated by the United States Bureau of Standards.

1-3. PRINCIPLES OF OPERATION.

1-4. WWV Standard Frequency Calibrator, Model RH-10 consists of an r-f amplifier, mixer, oscillator, i-f amplifier, and diode detector. The functions are all straight-forward as in the usual communication receiver. The higher frequency channel is pretuned by the permeability tuned coil. The lower frequency is pretuned by a trimmer condenser. Fine tuning is accomplished by a 3.5-7 mmf trimmer in the local oscillator circuit. Selective audio filters incorporated within the set enable the operator to make use of the modulation frequencies of 440 and 600 cycles per second. Voltage regulation is provided for the local oscillator to insure frequency stability.

1-5. APPLICATIONS.

1-6. GENERAL. There are several applications of this equipment. Four of these are described in the following paragraphs.

1-7. CHECKING THE PITCH OF MUSICAL INSTRUMENTS. 440 cycles per second is A4 (A above middle C) on the "Equal Tempered Chromatic Scale" which was adopted by Music Industries Chamber of Commerce of the United States in 1925. Accuracy is one part in 10,000,000.

1-8. CHECKING CLOCKS AND TIMING DEVICES. The time pulses of WWV are one second apart and accurate to 10 microseconds. Intervals of five minutes or longer are accurate to 1 part in 10,000,000.

1-9. CHECKING OR SETTING AUDIO FREQUENCIES. 440 and 600 cycles per second signals are accurate to 1 part in 10,000,000.

1-10. CHECKING OR SETTING RF FREQUENCIES, OR THE HARMONICS TO THE CARRIER FREQUENCIES OF WWV. Accuracy is 1 part in 10,000,000.

1-11. ELECTRICAL CHARACTERISTICS.

1-12. POWER INPUT. The power input is 90 volt-amperes at 115 volts, 60 cycles, single phase.

1-13. RF SENSITIVITY. The rf sensitivity is less than 0.5 microvolts.

1-14. SELECTIVITY. The selectivity is -10 db at ±5 KC.

1-15. IMAGE REJECTION RATIO. The image rejection ratio is -50 db.

1-16. FREQUENCY. The frequency is preset at 5 and 10 megacycles per second.

1-17. AUDIO OUTPUT VOLTAGE. The audio output voltage is adjustable from 0 to 5 volts.

1-18. OUTPUT IMPEDANCE. The output impedance is approximately 250 ohms.

1-19. EQUIPMENT SUPPLIED. (Refer to Table I.)

1-20. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-21. For any application of the WWV Standard Frequency Calibrator no equipment other than that normally available for that application will be required.

TABLE I. EQUIPMENT SUPPLIED

NAME	TYPE	QUANTITY
WWV Standard Frequency Calibrator	RH-10	1
Dust Cover		1
Bottom Plate		1

SECTION II
TEST EQUIPMENT AND SPECIAL SERVICE TOOLS

2-1. TEST EQUIPMENT.

2-2. No special test equipment is required by the operator for WWV Standard Frequency Calibrator, Model RH-10.

2-3. SPECIAL SERVICE TOOLS.

2-4. No special service tools are required by the operator for WWV Standard Frequency Calibrator, Model RH-10.

SECTION III
PREPARATION FOR USE

3-1. CONNECTING THE EQUIPMENT.

3-2. The equipment is ready for operation upon unpacking and connecting the line cord to the 105 to 125 volt, 50 or 60 cycle power line.

3-3. TUNING AND ALIGNING THE EQUIPMENT.

3-4. There are no special tuning or aligning procedures required for WWV Standard Frequency Calibrator, Model RH-10 during normal operation.

SECTION IV
OPERATION

4-1. OPERATION OF EQUIPMENT.

4-2. GENERAL. (See figure 4-1.) The WWV Standard Frequency Calibrator has six operating controls. These controls as indicated on the front panel are FINE TUNING, FREQUENCY MEGACYCLES PER SECOND, MASTER AUDIO GAIN, SPEAKER VOLUME, FUNCTION SELECTOR, and AUDIO OUTPUT LEVEL. Each of these controls is discussed in the following paragraphs.

4-3. MASTER AUDIO GAIN. The MASTER AUDIO GAIN Control, when rotated in the clockwise direction increases the gain of the entire audio system.

NOTE

It is best to use as low a gain setting as possible.

4-4. SPEAKER VOLUME. The SPEAKER VOLUME Control, when rotated in the clockwise direction increases the loud speaker output.

4-5. FUNCTION SELECTOR. The FUNCTION SELECTOR Switch settings determine the receiver operation.

4-6. The NORMAL setting makes the WWV Standard Frequency Calibrator operate as a normal receiver. The closing of the tuning eye indicates proper tuning of the receiver to the received signal.

4-7. The 440 ~ setting enables a highly-selective audio filter to pass only 440-cycle notes through the audio system.

4-8. The 600 ~ setting enables a highly-selective audio filter to pass only 600-cycle notes through the audio system.

4-9. The BEAT CARRIER setting permits a low-pass filter to allow only notes below 400 cycles to pass. The tuning eye is connected to the audio output so that it is possible to beat an external signal to WWV's carrier to a fraction of a cycle per second.

4-10. AUDIO OUTPUT LEVEL. The AUDIO OUTPUT Control when rotated in the clockwise direction increases the audio output.

4-11. FREQUENCY MEGACYCLES PER SECOND. The FREQUENCY MEGACYCLES PER SECOND Switch permits setting to either the 5 megacycle-per-second or 10 megacycle-per-second carrier of radio station WWV.

4-12. FINE TUNING. The FINE TUNING Control tunes the receiver local oscillator on either band. Adjust tuning for maximum closing of tuning eye.

4-13. STARTING PROCEDURE. To start the WWV Standard Frequency Calibrator turn the POWER Switch to ON and proceed as follows:

a. Turn the MASTER AUDIO GAIN Control clockwise to about 1/2 mesh.
b. Select the desired carrier frequency of either 5 or 10 megacycles-per-second.
c. Turn the FUNCTION SELECTOR Switch to NORMAL.
d. Turn the SPEAKER VOLUME Control to 3/4 maximum clockwise position.
e. Turn the MASTER AUDIO GAIN Control clockwise until noise is heard.

f. Turn the FINE TUNING Control clockwise or counterclockwise until the signals of WWV are heard.

NOTE

WWV may be identified by the tone modulation and by the one second interval pulses.

g. Turn the FINE TUNING Control slightly clockwise or counterclockwise for maximum closing of the tuning eye.

h. Turn the MASTER AUDIO GAIN Control clockwise or counterclockwise for desired level of volume from speaker.

NOTE

When r-f signals are exceptionally strong, the MASTER AUDIO GAIN Control should always be turned to the maximum counterclockwise position. To prevent distortion by overloading of the first audio stage, turn the SPEAKER VOLUME Control to 3/4 maximum clockwise position before turning the MASTER AUDIO GAIN Control to the position for comfortable listening.

4-14. STOPPING PROCEDURE. To turn off the equipment turn the POWER Switch Off.

Figure 4-1. WWV Standard Frequency Calibrator, Model RH-10, Front Panel Controls

SECTION V
INSPECTION AND PREVENTIVE MAINTENANCE

5-1. PERIODIC INSPECTION AND PREVENTIVE MAINTENANCE.

5-2. Table II, Routine Maintenance, indicates the items that should be checked, the time of checking and the method used to check to make sure that the WWV Standard Frequency Calibrator is operating at top efficiency.

TABLE II. ROUTINE MAINTENANCE

WHAT TO CHECK	WHEN TO CHECK	HOW TO CHECK
1. Electrical wiring damage.	Weekly	Observation
2. Capacitor leakage.	Weekly	Observation
3. Mechanical damage to component parts.	Weekly	Observation
4. Tube pins and socket contacts for corrosion.	Weekly	Observation
5. Resistors for evidence of overheating.	Weekly	Observation
6. Accumulation of dust.	Weekly	Observation
7. Operating controls for smoothness of operation.	Weekly	Turn controls to all possible positions.

5-3. LUBRICATION.

5-4. No lubrication is required.

5-5. TROUBLE SHOOTING.

5-6. GENERAL. Table III, Trouble Shooting Chart, the overchassis view (figure 5-1) and the schematic diagram (figure 5-2) will assist in locating faults occurring in the WWV Standard Frequency Calibrator.

TABLE III. TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
No noise is heard as the MASTER AUDIO GAIN Control is turned clockwise.	No input	Check power supply.
	Faulty tube(s)	Replace tube(s). (See paragraph 5-7.)
Tubes light, but receiver cannot receive signals. Loud rushing sound heard when MASTER AUDIO GAIN and SPEAKER VOLUME Controls are turned fully clockwise.	Trouble in r-f stage	Take voltage and resistance measurements (Table IV and Table V). Follow alignment procedures (paragraph 5-9).
No noise heard when MASTER AUDIO GAIN and SPEAKER VOLUME Controls are turned fully clockwise.	Trouble in audio or i-f stages	Take voltage and resistance measurements (Table IV and Table V). Follow alignment procedures (paragraph 5-8).

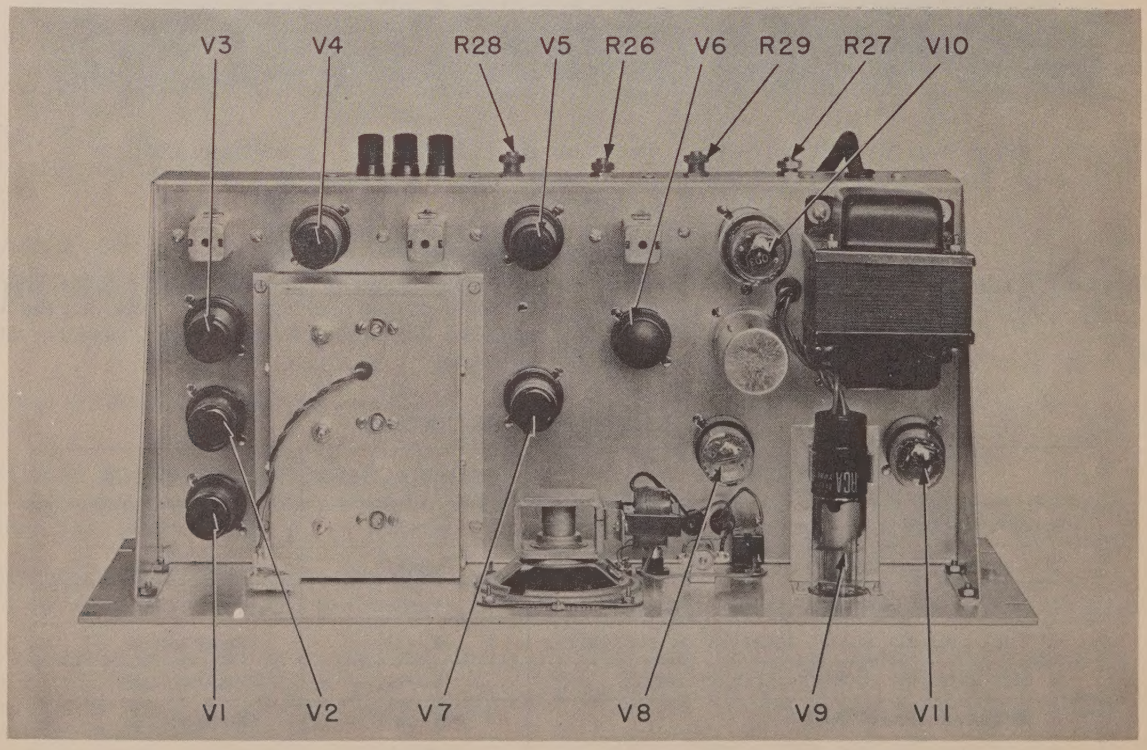


Figure 5-1. WWV Standard Frequency Calibrator, Location of Electron Tubes

5-7. REPLACEMENT OF ELECTRON TUBES. The tubes used in the WWV Standard Frequency Calibrator may become faulty through continued use and will have to be replaced. Because slight differences exist from tube to tube of the same type, the circuits affected must be readjusted when tubes are replaced. The Tube Replacement Chart, Table VI lists the tube complement and adjustments. (Refer to figure 5-1.)

m

TABLE IV. VOLTAGE READINGS OF TUBE SOCKET PINS

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V1 6SG7	0	0	0 1*	-1.6 -0.1*	.68 1.0*	133 90*	6.3V AC	260 230*
V2 6SA7	0	0	260 230*	89 65*	-1.1 -0.25*	1.95 1.3*	6.3V AC	0
V3 6J5	0	0	79 100*	145	-1.27 -0.25*	260 230*	6.3V AC	0
V4 6SK7	0	0	0	-0.43 -0.1*	0	102 75*	6.3V AC	252 205*
V5 6SK7	0	0	0	0.35 -0.1*	0	105 75*	6.3V AC	252 205*
V6 6H6	0	0	-0.65 -0.1*	0	-0.65 -0.1*	0	6.3V AC	0
V7 6SJ7	0	0	1.92 1.2*	0	1.92 1.2*	32 20*	6.3V AC	82 70*
V8 6SN7	0	260	8.3	0	270	8.1	6.3V AC	0
V9 6U5	0	0	-0.4	270 230*	0	6.3V AC	- - - -	- - -
V10 OD3/ VR150	270	0	0	-0.4 -0.1*	145	270	0	0
V11 5Y3	0	320 260*	0	320V AC 300V AC*	0	320V AC 300V AC*	0	320 260*

Use Simpson Model 260; meter sensitivity, dc 20,000 ohms per volt, ac 1000 ohms per volt.
Voltages are referred to the chassis with no signal input; voltages are dc unless marked otherwise.
Antenna shorted to ground; FUNCTION SELECTOR Switch at NORMAL.
FINE TUNING at half mesh; FREQUENCY Switch at 5 megacycles.

TABLE V. D-C RESISTANCE MEASUREMENT TO GROUND

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V1 6SG7	0	0	0 100*	1.5M 220K*	0 100*	X	0.1	X
V2 6SA7	0	0	X	X	54K 47K*	270 220*	0.1	0
V3 6V5	0	0	X	---	54K 47K*	5 meg. ---*	0.1	0

Note: * Denotes measurements or positions on Model RH-10's under Government Contract AF 33(604)12912 - May 1956

TABLE V. D-C RESISTANCE MEASUREMENTS TO GROUND (continued)

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V4 6SK7	0	0	0	1.6M 600K*	0	X	0.1	X
V5 6SK7	0	0	0	1.6M 600K*	0	X	0.1	X
V6 6H6	0	0	560K 400K*	0	560K 400K*	X	0.1	0
V7 6SJ7	0	0	4300 3300*	0.2 to 1 meg.	4300 3300*	X	0.1	X
V8 6SN7	0 to 520K	X	1500 1000*	0-1M 0-520K*	X	1000	0.1	0
V9 6U5	0	X	1.6M 600K*	X	0	0	---	---
V10 OD3/ VR150	---	0	----	----	X	---	---	---
V11 5Y3	---	X	----	120 75*	---	130 75*	---	X

Note: X resistance measured depends on the leakage resistance of C31 (C44-C45*) which varies from unit to unit. FUNCTION SELECTOR SWITCH at NORMAL.

TABLE VI. TUBE REPLACEMENT CHART

Reference Designation	Type	Function	Adjustment
V1	6SG7	R-F Amplifier	Retuning of L1 and Ca (C5*) may be necessary. This can be done by listening to WWV.
V2	6SA7	Mixer	Retuning of L2, C9 (C12*) and transformer T1 may be necessary
V3	6J5	Local Oscillator	Retuning is usually necessary
V4	6SK7	I-F Amplifier	Retuning of T1 and T2 may be necessary
V5	6SK7	I-F Amplifier	Retuning of T2 and T3 may be necessary
V6	6H6	Detector	Retuning of T3 may be necessary
V7	6SJ7	Selective audio amplifier	No adjustments are necessary
V8	6SN7	Speaker output & cathode follower	No adjustments are necessary
V9	6U5/ 6G5	Cathode Ray Tuning Eye	No adjustments are necessary
V10	OD3/ VR150	Voltage Regulator	No adjustments are necessary
V11	5Y3	Power Rectifier	No adjustments are necessary

Note: * denotes measurements or positions on Model RH-10's under Government Contract AF 33(604)12912 - May 1956

5-8. I-F AMPLIFIER. To align the i-f amplifier proceed as follows:

a. Place a high resistance d-c voltmeter (0-10 volts) across R18.
b. Connect an r-f signal generator, 456 kc to the grid of V5.
c. Adjust the permeability tuning slugs of i-f transformer T3 for maximum meter deflection.
d. Connect the 456 kc signal to the grid of V4.
e. Adjust the permeability tuning slugs of i-f transformer T2 for maximum meter deflection. Reduce the 456 kc signal strength, if necessary, to keep the meter on scale.
f. Connect the 456 kc signal to the grid of V2.
g. Adjust the permeability tuning slugs of i-f transformer T1 for maximum meter deflection. Reduce the 456 kc signal if necessary.

5-9. R-F STAGES. To align the r-f stages proceed as follows:

a. Place a high resistance d-c voltmeter (0-20 volts) across R18.
b. Connect a signal generator to the grid of V2 and set the test signal to the higher of the two pretuned frequencies.

NOTE

In the following procedures always adjust the test signal strength to keep the meter needle on scale.

c. Turn the FINE TUNING Control 1/2 clockwise.
d. Adjust the permeability tuning slugs of L3 to give maximum meter deflection.
e. Connect the test signal to the antenna terminals.
f. Adjust the permeability tuning slugs of L1 and L2 for maximum meter deflection.
g. Again connect the test signal to the grid of V2 and set the test signal to the lower frequency.
h. Adjust C14 (C17*) for maximum deflection.
i. Connect the test signal to the antenna terminal.
j. Adjust C9 (C12*) and C4 (C5*) for maximum meter deflection.

NOTE: *denotes measurements or positions on Model RH-10's under Government Contract AF 33(604)12912 - May 1956.

5-10. SELECTIVE AMPLIFIER. (Refer to figure 5-1.) To align the selective amplifier proceed as follows:

NOTE

The controls of the selective amplifier are aligned at the factory and are locked in place. No attempt should be made to retune them unless the amplifier absolutely refuses to function. Improper alignment may cause the circuit to be too selective and may even lead to oscillation or in the other extreme the selectivity may be lost.

a. Tune the calibrator to any carrier frequency of WWV or connect an audio test signal across R18.
b. Turn the FUNCTION SELECTOR Control to 440 ~. Turn Screwdriver Adjustment R29 counterclockwise. A howl should be heard in the speaker. Turn R28 clockwise approximately 15 degrees from the point where the howl disappears.
c. Adjust R26 for maximum audio output. This can be done by ear or by a meter or oscilloscope connected to the AUDIO OUTPUT terminals.
d. If higher selectivity is desired, turn R28 counterclockwise by a few degrees and retune R26. If lower selectivity is desired, turn R28 clockwise and retune R26.
e. Turn the FUNCTION SELECTOR Control to 600 ~. Turn R29 counterclockwise. A howl should be heard in the speaker. Turn R29 clockwise approximately 15 degrees from the point where the howl disappears.
f. Adjust R27 for maximum audio output. This can be done by ear or by a meter or oscilloscope connected to the AUDIO OUTPUT terminals.
g. If higher selectivity is desired turn R29 counterclockwise by a few degrees and retune R27. If lower selectivity is desired, turn R29 clockwise and retune R27.

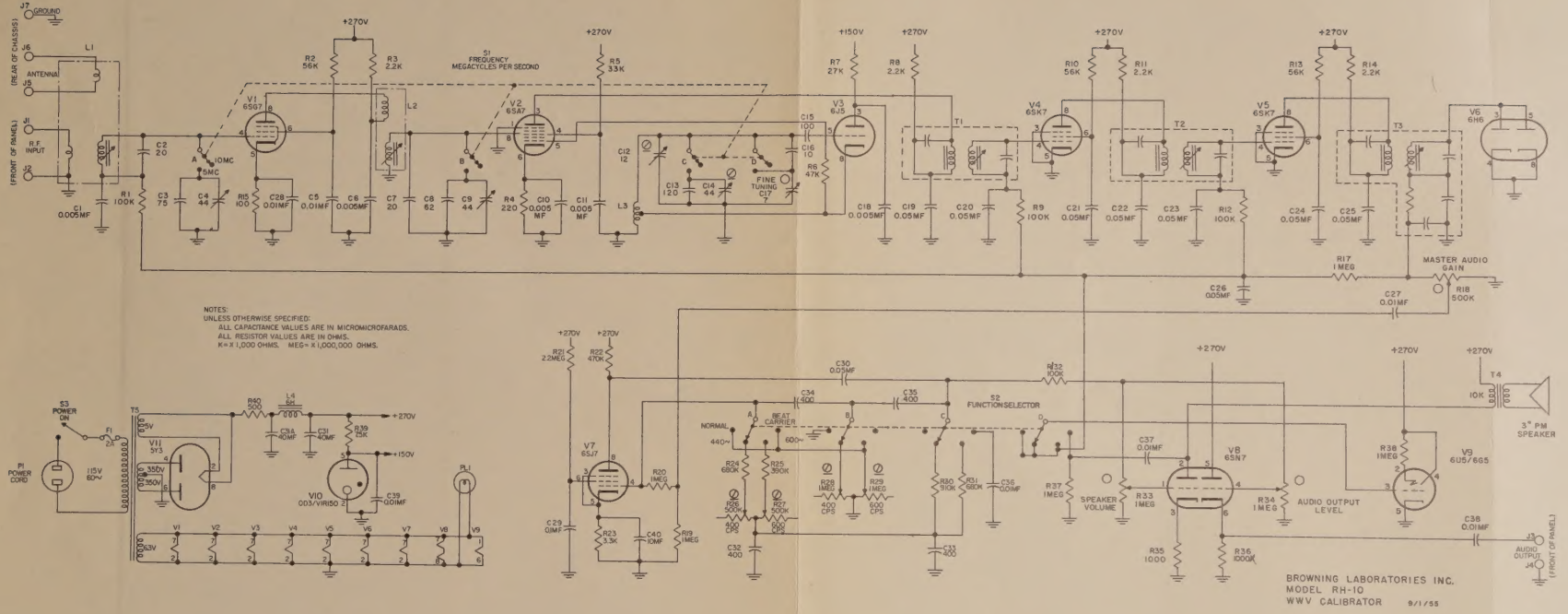
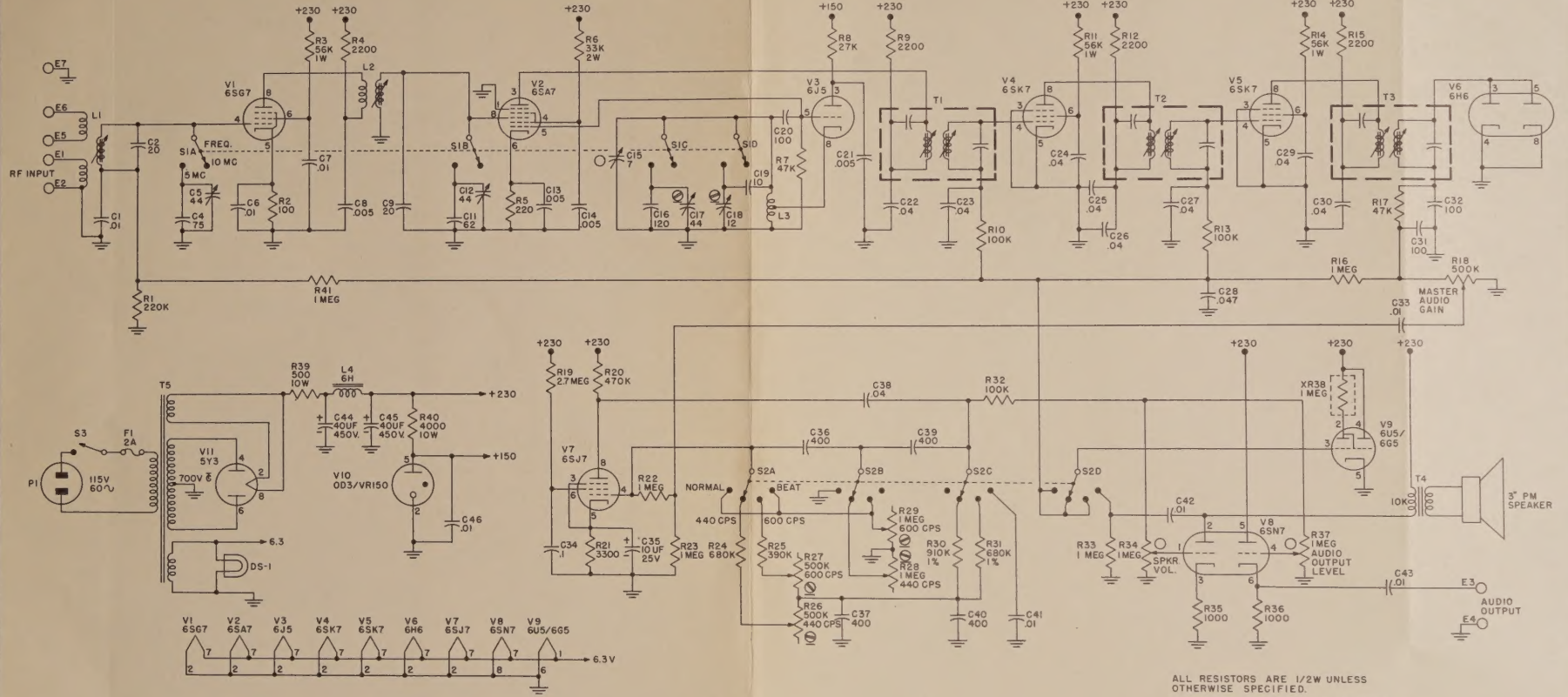


Figure 5–2. WWV Standard Frequency Calibrator, Model RH-10 Schematic Diagram



ALL RESISTORS ARE 1/2W UNLESS OTHERWISE SPECIFIED.

CAPACITORS EXPRESSED AS DECIMALS ARE IN MICROFARADS. THOSE EXPRESS AS WHOLE NUMBERS ARE IN MICRO-MICROFARADS; UNLESS OTHERWISE SPECIFIED.

JACKS J1 THRU J4 ARE ON FRONT PANEL.
JACKS J5, J6 & J7 ARE ON REAR OF CHASSIS.

Figure 5-3. WWV Standard Frequency Calibrator, Model RH-10 Schematic Diagram

Note: Applys to Government Contract No. AF 33(604) 12912